Express Mailing Certificate No. EU657648142US

AMENDMENTS TO THE SPECIFICATION

Add new paragraph beginning on page 1, line 3 as follows:

This application is a continuation in part of US patent application serial number 09/994,989, filing date September, 14, 2001, wherein said 09/994,989 application is pending.

Paragraph beginning on page 14, line 2 and ending on page 14, line 11 has been amended as follows:

In accord with a preferred embodiment of the invention, a method is provided for passively detecting the location of the transmitter wherein the transmitter emits a signal of a known frequency and known modulation scheme comprising one or more steps, such as for instance, receiving the transmitter signal with a first antenna array comprising a first antenna element that produces a first received signal, a second antenna element that produces a second received signal, and a third antenna element that produces a third received antenna signal. Other steps may include determining a first phase difference between the first received signal and the second received signal, determining a second phase difference between the first received signal and the third received signal, and utilizing the first phase difference and the second phase difference to determine a first vector in the direction of the transmitter from the first antenna array.

Paragraph beginning on page 14, line 12 and ending on page 15, line 3 has been amended as follows:

In one embodiment, the method may include receiving the transmitter signal of a known frequency and known modulation scheme with a second antenna array spaced from the first antenna array, the second antenna array comprising one or more elements, such as for instance, a fourth antenna element that produces a fourth received signal, a fifth antenna element that produces a fifth received signal, and a sixth antenna element that produces a sixth received antenna signal, determining a third phase difference between the fourth received signal and the fifth received signal, determining a fourth phase difference between the fourth received signal and the sixth received signal, and utilizing the third phase difference and the fourth phase difference to determine a second vector in the direction of the transmitter from the second antenna array. Additional steps may further comprise utilizing the first vector and the second vector for locating the transmitter.

Paragraph beginning on page 18, line 9 and ending on page 18, line 18 has been amended as follows:

A method for a passive system in accord with the present invention may be provided for determining location characteristics of a plurality of moveable transmitters, wherein each of the plurality of moveable transmitters preferably produces a transmitter signal of a known frequency and known modulation scheme, comprising steps such as providing a plurality of receivers spaced apart wherein each of the plurality of moveable transmitters is receivable by at least one of the plurality of receivers, providing each receiver with an antenna array preferably with three spaced apart antenna elements, determining a pair of transmitter signal phase shifts at the three

spaced apart antenna elements for a respective first moveable transmitter and first receiver, and utilizing the pair of transmitter signal phase shifts to determine a first direction of the first moveable transmitter with respect to the first receiver.

Paragraph beginning on page 22, line 3 and ending on page 22, line 19 has been amended as follows:

The present invention provides a quickly operating, inexpensive, system and method for locating a transmitter in 3-D space (in x, y, and z). Location times may typically be determined real time (less than one second). The accuracy of location is comparable to that of GPS location systems and is typically at least within tens of feet but may potentially be considerably more precise depending on the particular mode of operation as discussed hereinafter. In a preferred embodiment, the transmitter may be a standard communications transmitter, such as a cell phone or other communications transmitter, and it is desired to determine the location thereof. Thus, the transmitter sends a standard data-modulated signal <u>of a known frequency and known modulation scheme</u>, which could be any type of communications signal. An advantage of the present invention is that a special distress signal is not required for operation of the invention so that the present invention can simply be used as an inexpensive, add-on feature to any communications system. However, the invention would also be operable for locating the transmitter if a special distress signal were to be used. Therefore, in a preferred embodiment, a small-sized, quick operating, low cost device in accord with the present invention may be added

on to already existing communication systems, such as cellular telephone networks, to provide quick, accurate, and inexpensive location information.

Paragraph beginning on page 25, line 5 and ending on page 25, line 9 has been amended as follows:

Expressing the unit vector in spherical coordinates as shown in FIG. 2, one obtains the phase differences:

$$\Phi_1 = \pi \sin\theta \cos\phi$$
$$\Phi_2 = \pi \sin\theta ~~\cos\phi~~ \underline{\sin\phi}$$

for the phase shifts. Inversion of these equations yields

$$\phi = \arctan\left(\frac{\Phi_2}{\Phi_1}\right)$$
$$\theta = \arcsin\left(\frac{\sqrt{\Phi_1^2 + \Phi_2^2}}{\pi}\right)$$

Paragraph beginning on page 26, line 12 and ending on page 26, line 17 has been amended as follows:

In one particular embodiment of the invention for a particular <u>known</u> modulation scheme, the baseband data is orthogonally coded and then spread into two channels using two independent PN (pseudo noise) codes. In this example, the data in these channels QPSK (quaternary phase shift keying) modulates an RF (radio frequency) signal or carrier at an RF

frequency. Other types of modulation schemes could also be used, some of which are mentioned hereinafter.

Paragraph beginning on page 42, line 7 and ending on page 43, line 4 has been amended as follows:

In summary, three-element array 10 is operable over a theoretical hemisphere (i.e., 180 degree field of view) in conjunction with receiver 30 that has three channels to simultaneously receive the transmitted signal with each of the three antenna elements. The actual operational field of view is dependent on the antenna system used. For example, a three-element array of microstrip patch antennas can provide an actual operational field of view of about 140 degrees. If the distance between the transmitter and array 10 can be measured via a one-way ranging system, or other intersection means such as knowledge of a particular track that the tracked item will follow, then only one direction vector/3-element antenna array system/receiver is needed to determine the transmitter position. Otherwise, two arrays 10 can be utilized to produce two 3-D vectors from each respective array 10, whose relative spacing is known, to thereby locate the transmitter. The vectors may be produced by determining the phase differences between the array elements by any means for measuring phase differences between signals although a preferred implementation is disclosed that is inexpensive, operates quickly, and is conveniently useable with already existing communication systems. In a preferred embodiment, a technique is utilized for extracting the phase difference between the transmitter and receiver in a noncoherent demodulation scheme and using the phase difference to produce a unit vector for

detecting the transmitter location. The operation requires less than one second and may typically have an accuracy as good as or better than most commercial GPS locating systems. However, the accuracy can be improved if desired depending on the mode of operation.